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## I. ASTRONOMY

### Abstracts of Scientific Articles

#### CHARACTERISTICS OF GRAVITATIONAL FIGURE OF MARS

Moscow ASTRONOMICHSKIY ZHURNAL in Russian Vol 55, No 4, 1978 pp 834-844

[Article by G. A. Meshcheryakov and A. L. Tserklevich, Geodesy Faculty, L'vov Polytechnic Institute, "Global and Regional Characteristics of Martian Gravitational Figure"]

[Abstract] By the gravitational figure of Mars (areoid) is meant the level surface of gravity potential of the planet which limits in space a body of the same volume and mass as the real planet and is described by a definite number of Stokes constants  $c_{nm}$ ,  $s_{nm}$ . This article discusses areoidal surfaces corresponding to models of the planetary gravity field proposed by Jordan and Lorell, taking into account terms to the fourth order, by Born -- with terms to the sixth order, as in the case of Reasenberg, et al., and by S. Sjogren -- to the ninth order, and considers their principal peculiarities. The finding of level surfaces from the parameters of the external gravitational field was accomplished using the iterations method proposed for this purpose by G. A. Meshcheryakov. The radius-vectors of the areoid were computed at the points of intersection of a cartographic grid  $\Delta\theta = \Delta\lambda = 20^\circ$  with an accuracy to  $1 \cdot 10^{-6}$ . The undulations of the areoid are given relative to a triaxial ellipsoid with stipulated parameters. The global and regional characteristics of the Martian gravity field are discussed. Its close correlation with the physical surface of the planet is noted.

[556]

## II. METEOROLOGY

### News

#### NEW WEATHER CONTROL EFFORTS IN ARMENIA

Moscow PRAVDA in Russian 15 Sep 78 p 6

[Article by A. Androshin: "Can We Control the Rain?"]

[Abstract] Preparations are being made for a major experiment for producing precipitation. The following information was supplied by the Director of the Institute of Applied Geophysics, Academician Ye. K. Fedorov.

The experiment is being carried out in the mountains of Armenia, near Lake Sevan. There plans call for use of a combination of methods for modifying clouds. The sky over the water surface will be furrowed by specially outfitted aircraft, antiaircraft guns will be aimed at the clouds for firing shells filled with silver iodide, and powerful aerosol generators will come into play. At an elevation of 2,300 m above sea level there will be an unusual apparatus; to the roar of aircraft jet engines a stream of hot air will be expelled upward at an enormous velocity. An effort will be made to induce greater precipitation. Specialists of the Institute of Applied Geophysics and other institutes recognize the great importance of Lake Sevan in the production of electric power and especially in irrigation of the Aragatskaya valley and the foothill regions of Armenia. The level of this important lake has begun to drop. The area of the water body has decreased by 420 km<sup>2</sup>. The lake level could be raised by artificial precipitation provided that this precipitation falls regularly and only when it is required. Specialists have calculated that in order to maintain the lake level it is sufficient to increase the quantity of precipitation in the Sevan basin on the order of 10-15%. Supplementing the already well-known methods, here use will be made of a gigantic apparatus known as a supermeteotron. It is intended for creating a powerful, upward-directed current of hot air capable of exerting an influence on the formation and development of clouds. The first Soviet supermeteotron was designed by leading engineers of seven research institutes in Moscow, the Ukraine, Transcaucasia and the Baltic region. The powerful ascending currents of hot air will be driven upward by six aircraft jet engines. Cooling aloft, the currents can give rise to

clouds over Lake Sevan. The engines are arranged in a circle, at the points of a six-pointed star, at equal distances from one another. These are connected to a chamber at the center where the currents merge into a single flow. The air enters a tower and there is heated to a temperature of 1,100°. Its initial velocity should be almost double the speed of sound. The apparatus rises to the height of a six-story building and its total power is about a million kilowatts. It covers an area of a third of a hectare. The currents rise into the atmosphere for approximately three kilometers. The results of the experiment will be checked by special radars and a network of automatic rain gages and other instruments. The supermeteotron is not quite finished. The tower must be erected, the master control panel must be installed and different communication lines must be laid.

[571]

### Abstracts of Scientific Articles

#### SPECTRA OF TURBULENCE AND INTERNAL WAVES IN ATMOSPHERIC BOUNDARY LAYER

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 14, No 7, 1978 pp 709-715

[Article by N. L. Byzova and T. A. Kal'yankina, Institute of Experimental Meteorology, "Spectra of Turbulence and Internal Waves in a Stably Stratified Atmospheric Boundary Layer According to Observations on a High Mast"]

[Abstract] Turbulence or internal waves can develop in a stably stratified layer of fluid with a velocity shear. The degree of stability of the fluid medium is determined by the Richardson number and there is some critical value  $Ri_{cr}$  which when exceeded the turbulence is suppressed. When  $Ri > Ri_{cr}$  in the frequency range below the Brent-Väisälä frequency there can be free and forced internal waves without nonlinear interaction, without a cascade energy transfer. At the same time, in the higher-frequency region there can be nonlinear interactions associated with the disturbing influence of velocity shear. In the case of  $Ri$  values close to the critical level there can be development of local instability and excitation of Kelvin-Helmholtz waves and a cascade energy transfer can appear. Accordingly, the authors have analyzed the spectra of fluctuations of temperature and the wind velocity components in the stably stratified atmospheric boundary layer in the case of well-developed turbulence and during the passage of internal waves. In the second case there are distinct matched maxima in the auto- and cross-spectra and high coherence at the corresponding frequencies. The errors in determining the phase angles of the cross-spectra are discussed.

[547]

### III. OCEANOGRAPHY

#### Abstracts of Scientific Articles

##### FLUCTUATIONS OF BRIGHTNESS OF UNDERWATER LIGHT FIELD

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 14, No 8, 1978 pp 887-893

[Article by V. G. Yakubenko and V. P. Nikolayev, Institute of Oceanology,  
"Experimental Investigations of Brightness Fluctuations of the Underwater  
Light Field"]

[Abstract] Investigations of brightness fluctuations of the underwater light field were carried out using the "Chernomor" manned underwater laboratory during 1972-1974. Radiation detectors with an angular aperture of 3-6° were mounted in rotating units of a mast standing on the sea floor at a distance of 25-30 m from the sealab. Mounted on the upper part of the mast and protruding from the water was a string-type current recorder and a sensor of above-water illumination. The technical servicing of the sensors, their orientation and movement was accomplished by divers. The recording apparatus was installed in the sealab, on the servicing ship or on shore. The article gives an analysis of the change in the variation coefficient and the energy spectral density of brightness fluctuations with depth, the correlation of the statistical characteristics of the underwater light field with the characteristics of waves and the cross-correlation function of brightness fluctuations of the underwater light field at different points in the horizontal plane.

[578]

##### EFFECT OF MESOSCALE EDDIES ON TEMPERATURE OF OCEAN SURFACE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 14, No 7, 1978 pp 768-777

[Article by B. A. Nelepo, Yu. M. Kuftarkov and V. K. Kosnyrev, Marine Hydro-physical Institute, "Effect of Mesoscale Eddies on Ocean Surface Temperature"]

[Abstract] The objective of this study was formulation of a model of the upper quasihomogeneous layer of the ocean and its evolution in the presence of mesoscale eddies. The following assumptions were made: 1. The thermal

structure of the mesoscale disturbances is characterized by considerable vertical movements of the isotherms in the main ocean thermocline. The direction of these movements is in an unambiguous correspondence with the sign of the eddy field. 2. The geostrophic velocities of the disturbances to a considerable degree are baroclinic. Eighty percent of the geostrophic velocity of the currents in the eddy field is caused by the density distribution in the upper 1,500-m layer of the ocean. The influence of deep mesoscale disturbances (eddies, rings) leads to an intensification of the temperature jump situated below the quasi-isothermic layer and a marked intensification of the vertical temperature gradient in it. 3. The field of currents in the homogeneous layer is in quasigeostrophic equilibrium with the horizontal density gradients. Using this model the authors give the results of computations of the temperature field in this layer. The possibilities of using this model in the interpretation of observational data obtained from satellites are discussed. Under definite conditions the homogeneous layer of the ocean is a carrier of valuable information on the structure and some parameters of deep mesoscale eddies. The mathematical models of the type proposed in this article can be used as "filters" for filtering out the noise introduced by the influence of currents, wind and heat flows at the ocean surface.

[547]

#### STUDY OF SEA BOTTOM USING SIDE-SCANNING SONAR

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA. GEOGRAFIYA in Russian No 4, 1978 pp 101-106

[Article by Ye. I. Ignatov and B. K. Fuks, Geomorphology Department, Moscow State University, "Study of Relief of the Sea Floor Using a Phase-Type Side-Scanning Sonar"]

[Abstract] The article gives a brief description of a possible variant of a phase-type side-scanning sonar, an analysis of some sources of measurement errors, and demonstration of the practical material obtained using a model of this instrument. After outlining the principle for measuring depths by the phase-type side-scanning sonar, the authors deal with one of the possible versions of the phase method and the measurement errors involved. The advantages of systems with multiray scanning over standard echo sounder measurements are presented. With an equal density of the survey runs of a ship the amount of relief data obtained is immeasurably greater in comparison with echo sounder measurements. Accordingly, some advantage of the echo sounder in accuracy is reduced to zero due to the appearance of interpretation errors which increase as relief forms become more complicated. The closer spacing of depth sounding runs to a certain degree makes up for the shortage of relief data and reduces the interpretation errors, but there is an accumulation of errors of a different kind, associated with navigational errors. In addition, there is an increase in cost and the productivity of

the survey is reduced, that is, in this variant the new type of survey is also more productive.

[573]

#### STRUCTURE OF AXIAL ZONE OF SOUTHWESTERN KURILE-KAMCHATKAN TRENCH

Moscow GEOTEKTONIKA in Russian No 4, 1978 pp 70-78

[Article by B. I. Vasil'yev, E. G. Zhil'tsov and A. A. Suvorov, Sakhalin Multidiscipline Scientific Research Institute, "Structure of the Axial Zone of the Southwestern Part of the Kurile-Kamchatkan Trench"]

[Abstract] In the summer of 1976 an expedition of the Sakhalin Multidiscipline Scientific Research Institute aboard the research ship "Pegas" carried out 14 crossings of the Kurile-Kamchatkan trench in the sector from 148 to 154°E and also ran one profile along the axis of the trench with a length of 200 km (Fig. 1). On all the profiles specialists carried out depth measurements, continuous seismic profiling by the central ray method and gravimetry and on some profiles, magnetometry as well. Dredging was carried out on the slopes of the trench and elsewhere. The studies confirmed that the axial zone of the trench separates regions having a different structure and a different history of development. This boundary, at least in the upper part of the earth's crust, is not sharp but has the nature of a facies transition. The shallow-water coarse deposits making up the lens in the axial part of the island slope, gradually decreasing in thickness, are replaced by pelagic deposits of the oceanic slope of the trench. The greatest thickness of the sedimentary lens was noted 15-20 km to the northwest of the trench axis, as is confirmed by gravimetric observations. A relative decrease in gravity is associated with this zone. Accordingly, the axial part of the trench at the beginning of formation of the sedimentary lens was situated closer to the islands and then was pinched to the northeast as the trench was filled with sediments. If the mean thickness of the sedimentary lens is assumed to be 2 km, and its width -- 40 km, the volume of sediments per 1 km of extent of this trench is 80 km<sup>3</sup>. Assuming a Neogene age of the rocks making up this lens, it can be computed that the average rate of sedimentation was 10 cm per 1,000 years, which is characteristic for the continental margins.

[553]

## DENSITY OF SURFACE LAYER OF SEDIMENTS ON ATLANTIC FLOOR

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 241, No 6, 1978 pp 1432-1435

[Article by A. V. Il'in and I. I. Shurko, "Density of Surface Layer of Sediments on the Atlantic Ocean Floor"]

[Abstract] A new map of density of the surface layer of sediments on the floor of the Atlantic Ocean is presented (Fig. 2 in text). Within the framework of the map it is possible to define three principal density gradations:  $< 1.4$ ,  $1.4-1.7$ ,  $> 1.7$  g/cm<sup>3</sup>. In general, the lowest values are associated with the bottom of abyssal basins covered with clayey and diatomaceous oozes. The intermediate density gradation corresponds to calcareous and terrigenous sandy-silty deposits of the foot of the continental shelf, Mid-Atlantic Ridge and abyssal rises. The maximum densities are characteristic for terrigenous, volcanic and calcareous sediments on the shelf. However, a comparison of the densities map with a bathymetric chart of the Atlantic Ocean floor shows that there are substantial differences between them. Most importantly, the densities map has an asymmetric form relative to the axis of the Mid-Atlantic Ridge. To the west of it a zone of low densities extends along the entire ocean, being interrupted only on positive relief forms. In the eastern part of the ocean there is only one extensive region of low densities of sediments, corresponding to the Guinea and Angola basins. The data cited in this article characterize density only of the unconsolidated sandy-silty-pelitic material, not relating to the various inclusions in the sedimentary layer -- ferromanganese nodules, material transported by the ice, and rock fragments of other origin. The total density of bottom deposits with such inclusions will be considerably greater. In general, the denser sediments are characteristic for the eastern part of the ocean and the less dense sediments are characteristic for the western part. These differences are determined for the most part by different sedimentation rates, nonuniform distribution of eolian material and amorphous silicon.

[580]

## DISPLACEMENT OF SOUND SCATTERING FUNCTION MAXIMUM ON WAVE-COVERED OCEAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 241, No 6, 1978 pp 1440-1442

[Article by Yu. P. Lysanov, Acoustics Institute, "Displacement of the Sound Scattering Function Maximum on the Wave-Covered Ocean Surface"]

[Abstract] One of the most important energy characteristics of the sound scattered on the wave-covered ocean surface is the scattering function, determining the angular distribution of the intensity of the sound field in the distant zone. In solving some practical problems it is necessary to know not only the form of the scattering function, but also the direction of its maximum. In this paper the author examines the effect of deviation of the

sound-scattering maximum of high-frequency sound from the direction of mirror reflection caused by asymmetry of the distribution of sea wave slopes and gives a numerical evaluation of the degree of the effect. It is shown that the direction of the sound-scattering maximum corresponds to the direction of mirror reflection from a plane whose slope is equal to the mean slope of the surface waves. The sound-scattering maximum deviates from the direction of mirror reflection only relative to the horizontal plane. In the case of small glancing angles of the incident sonic wave the displacement of the scattering function maximum can be caused both by the natural asymmetry of the surface wave slopes and the "effective" asymmetry, arising due to shading of some sectors of the wave-covered surface. The total deviation can both increase and decrease in dependence on the direction of propagation of the sonic wave relative to the wind. In the absence of shading the displacement of the scattering function maximum is not dependent on the angle of incidence of the sonic wave and this facilitates the experimental checking of this phenomenon, making it possible to select the most convenient conditions for carrying out field measurements.

[580]

#### IV. TERRESTRIAL GEOPHYSICS

##### Abstracts of Scientific Articles

###### METHOD FOR INCREASING ACCURACY OF BALLISTIC GRAVIMETER

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 5, 1978 pp 111-118

[Article by L. D. Gik and M. G. Smirnov, "Method for Increasing the Accuracy of a Ballistic Gravimeter Under the Influence of Inertial Accelerations"]

[Abstract] In an earlier paper with the same title by the same authors (GEOL. I GEOFIZ., No 4, 1977) there was a discussion of methods for increasing the protection of a ballistic gravimeter against vibrations based on frequency filtering: use of systems for protection against vibrations and the introduction of corrections into the measurement results. This new paper examines a third effective method for decreasing the influence of movements of the gravimeter base -- control of the moment of its triggering. This is the most effective of the three methods. It also involves the introduction of a system for protection against vibrations in combination with methods for the statistical processing of the measurement results. With a period of characteristic oscillations of the vibroprotection system  $T_0 = 10-30$  sec and a parametric change in damping this method will make it possible to reduce the measurement error by a factor of 75-300.

[557]

###### DETERMINING DEFORMATION COMPONENTS FROM DATA ON RECENT CRUSTAL MOVEMENTS

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 5, 1978 pp 125-128

[Article by S. I. Kesel'man, Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences, "Determination of Components of Deformation from Data on Recent Crustal Movements on a BESM-6 Computer"]

[Abstract] For the first time it has been possible to define a program for determining the components of deformation of the earth's crust using data from repeated observations of horizontal geodetic networks. On the basis

of the local coordinates of points and vector schemes of their horizontal movements it makes it possible to ascertain such parameters as maximum and minimum dilatation, shear, direction of the principal axes of deformation and rotation. The program is standard because the deformation components can be computed for figures of different geometrical configurations. The program was tested in the example of the vector field of horizontal movements in the zone of the Krivoy Rog deep fault. The method makes it possible to use data on recent movements for solving many problems in tectonophysics and in particular, to trace the development of deformations with time.  
[557]

#### METHOD FOR DETERMINING VELOCITY OF SEISMIC WAVE PROPAGATION

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 7, 1978 pp 86-89

[Article by V. Yu. Burmin, Institute of Physics of the Earth, "Determination of Velocity of Seismic Wave Propagation in a Waveguide from the Travel-Time Curve of Refracted Waves"]

[Abstract] The article gives a method for determining the velocity of propagation of seismic waves in a waveguide from the travel-time curve of refracted waves. The problem is formulated in the following way. In the plane  $xz$  at the point  $(0, 0)$  there is a source of seismic pulses. From the travel-time curve  $t = t(x)$  on the surface  $(x, 0)$  it is necessary to determine the velocity of pulse propagation. It is assumed that: 1) velocity  $v$  is a function only of depth, that is,  $v = v(z)$ ; 2) everywhere outside the waveguides the velocity  $v(z)$  increases continuously with depth; the path of the rays along which the pulses are propagated conforms to the Fermat principle. In this formulation the problem is solved. The results are also correct for a spherically symmetric medium. For this it is necessary to transform from the travel-time curve equations for a sphere to the equations for a half-plane.  
[552]

#### MODELING PROCESS OF FORMING OF MAGNETICALLY ACTIVE LAYER IN MID-OCEANIC RIDGES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 7, 1978 pp 54-62

[Article by M. B. Leibov and Ye. G. Mirlin, Geology Faculty, Moscow State University, and Institute of Oceanology, "Modeling of Process of Formation of Magnetically Active Layer in the Axis of Mid-Oceanic Ridges"]

[Abstract] The authors propose a model of formation of a magnetically active layer in the axis of mid-oceanic ridges, being a development of the Vine-Matthews hypothesis and taking into account the discreteness of receipt of

material in the process of spreading of the ocean floor. Also examined are the parameters which to the greatest degree govern bottom relief and the structure of magnetic anomalies in the axis of a rift valley. The first conclusion to be drawn from the model is that the appearance of the short-wave component of the magnetic field is caused not only by the complex relief of the magnetically active layer, but also by the nonuniform distribution of magnetization within it. The second conclusion is that the alternation of layers of oppositely magnetized basalts in the cores of deep-drilled boreholes can at least partially be attributed to flows of basaltic lavas which were formed in epochs with different signs of the geomagnetic field, with displacements of the center of introduction of the material. A third conclusion is that the mesorelief of the mid-oceanic ridges is caused to a considerable degree by the discreteness of the process of receipt of volcanic material. The proposed model is kinematic. It does not take into account the processes of tectonic fragmentation of the magnetically active layer, changes and oxidation of the titanomagnetites present in the pillow lavas. Obviously, with increasing distance from the spreading axis the role of these processes will increase and at a considerable distance from the axis a substantial contribution to the formation of the magnetic anomalies will be made by the rocks of the lower-lying dike complex.

[552]

#### COMPARISON OF METHODS FOR INTERPRETING GEOPHYSICAL DATA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 6, 1978 pp 77-85

[Article by G. S. Vakhomayev and A. Yu. Davydenko, Irkutsk Polytechnic Institute, "Comparison of Multidimensional Methods for the Complex Interpretation of Geophysical Data: Complex Geophysical Index Function and Main Components Method"]

[Abstract] The possibilities of linear methods of multidimensional analysis are examined for the interpretation of data from complex geophysical investigations. It is shown that on the basis of concepts on a physical geological model of the object of search in many cases it is simpler to select the form of the complex geophysical index function, taking into account the corresponding weighting coefficients of the individual criteria, than to carry out selection of the main components discriminated using the criterion of the maximum of the dispersion of linear combinations of initial parameters.

[561]

## EFFECT OF LITHOSPHERIC-ASTHENOSPHERIC VISCOSITY DIFFERENCE ON ISOSTASY

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 6, 1978 pp 86-92

[Article by S. A. Tychkov, Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences, "Effect of Difference in Viscosity of the Lithosphere and Asthenosphere on Isostatic Regulation Processes"]

[Abstract] A study was made of the influence of the viscosity jump on the rate of isostatic regulation and the stressed state of the lithosphere and asthenosphere. The process of isostatic regulation is modeled by the behavior of a two-layer viscous fluid with an initial sinusoidal disturbance at the boundary of the layers. The authors discuss the dependence of isostatic regulation on the rheological state of the mantle and on deep processes, especially on convection in the mantle. A decrease in the viscosity of the underlying layer by two orders of magnitude has the result that the rate of isostatic regulation increases by 1-2 orders of magnitude in comparison with the case of equal viscosities. The characteristic time of the process is  $T \sim 10^9 - 10^{13}$  sec in comparison with  $T \sim 10^{10} - 10^{14}$  sec for an identical viscosity. With a decrease in viscosity the kinematic stresses are reduced by 2-3 orders of magnitude. If the thickness of the first layer  $h = 50$  km (for the continents), a viscosity jump by two orders of magnitude is adequate for the viscosity of the second layer not to exert a significant influence on the duration of isostatic regulation. If a viscosity jump is absent, regulation occurs  $10 - 10^3$  times more slowly.  
[561]

## EXCITATION OF ELASTIC WAVES BY UNDERGROUND UNVENTED EXPLOSION

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 6, 1978 pp 93-102

[Article by B. P. Sibiryakov, T. Ya. Blagovidova and A. V. Trigubov, Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences, "On the Theory of a Deep Underground Unvented Source of Transverse Waves"]

[Abstract] The authors have formulated a theoretical model for computing the intensity and direction of P and S waves during explosions set off at some distance from an underground cavity. The field of S waves of such a source is completely inverted and the field of P waves is completely not inverted with a reversal of the sign of the effect. This circumstance is true in both the distant and near zones. Therefore this scheme differs greatly from a point force where there is an inversion of both the S and P waves. The ratio  $A_S/A_P$  with an increase in distance from the center of the unvented cavity to the charge usually decreases and for low frequencies far more sharply than for the high frequencies. The filling of the unvented cavity with water in the case  $\gamma = 0.5$  leads to a more rapid drop in the intensities of S waves

with an increase in distance between the explosion and the cavity; all the frequencies of the seismic range behave identically with respect to the decrease of  $A_g/A_p$  with distance. Anomalously low  $\gamma$  values lead to an increase in the  $A_g/A_p$  ratio in the low-frequency part of the spectrum. However, the realization of this increase is possible only with sufficiently "accurate" energy sources (detonation of liquid or gaseous explosives or vibrational excitation).

[561]

#### USE OF SPACE PHOTOS FOR DETECTING ORE-CONTROLLING STRUCTURES

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR. SERIYA GEOLOGICHESKAYA in Russian No 4, 1978 pp 51-54

[Article by F. M. Ibragimov, A. K. Kiselev and Ye. S. Bazhanova, South Kazakhstan Territorial Geological Administration, "Possibilities of Using Space Photographs for Detecting Ore-Controlling Structures in the Northern Balkhash Area"]

[Abstract] In the promising copper ore region of the Northern Balkhash region the interpretation of space photographs revealed poorly expressed deep faults at the surface which were not noted when carrying out all types of preceding geological-geophysical investigations. On the basis of a joint analysis of metallogenetic forecasting information and the results of interpretation it was possible to confirm their ore-controlling importance and shows of copper were discovered within the limits of the newly discovered zone of the Kylatunskiy fault.

[1]

#### MORPHOLOGICAL CHARACTERISTICS OF APPEARANCE OF NEOTECTONIC DISLOCATIONS

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR. SERIYA GEOLOGICHESKAYA in Russian No 4, 1978 pp 54-60

[Article by L. I. Platanova and A. V. Timush, Order of the Red Banner of Labor Institute of Geological Sciences Kazakh Academy of Sciences and Kazakh State Institute for the Planning of Cities and Regional Planning, "Morphological Peculiarities of Manifestation of Neotectonic Dislocations in Depressions of Southeastern Kazakhstan"]

[Abstract] The article presents data on the manifestations of the recent tectonic movements in the Southern Balkhash region and in the Ili depression, to one degree or another reflected in the surface structure. The

uniformity of lithology and reworking by exogenous processes make difficult the determination of the evidences of manifestation of the most recent tectonic movements. However, an analysis of the peculiarities of relief with the use of aerial photographs made it possible to discriminate several groups of criteria of geomorphological expression of the most recent dislocations: configuration and orientation of depressions, eolian sands, scarps, configuration of river channels, forms of shorelines of Lake Balkhash, hypsometry of the surface and other criteria. The paper presents specific examples of neotectonic dislocations in the unconsolidated cover. [1]

#### SPACE PHOTOGRAPHS OF STRUCTURE OF BAYKAL RIFTS

Moscow SOVETSKAYA GEOLOGIYA in Russian No 8, 1978 pp 131-137

[Article by L. G. Vasyutina and A. P. Kuskov, "Aerogeologiya" Combine, "Structure of the Zone of Baykal Rifts According to Data from Space Photographs"]

[Abstract] An interpretation of space photographs, accompanied by an analysis of regional geological and geophysical materials, and also field checking of interpreted features, makes it possible to trace the zone of Baykal rifts from Lake Baykal through the system of Muysko-Charsko-Tokkinskiye depressions to the east at the headwaters of the Aldan River, through the valleys of the Iyengra-Gonam, Tuksani Rivers to the headwaters of the Zeya-Maya Rivers. It is postulated that it continues to Udskeya Guba in the Sea of Okhotsk. The rift zone includes large depressions of the Baykal type, their small structural analogues, "incipient" depressions and graben valleys. Despite the discordant position relative to the ancient structures, the zone of Baykal rifts has definite characteristics of inheritance. The interpretation of space photographs with subsequent ground checking and interpretation made it possible to obtain new data on the structure of the zone of Baykal rifts and to some degree makes it possible to solve some problems relating to continental rifts.

[2]

#### CRUSTAL STRUCTURE IN CHU-SARYSUYSKAYA DEPRESSION

Moscow SOVETSKAYA GEOLOGIYA in Russian No 8, 1978 pp 93-107

[Article by R. A. Eydlin and M. S. Erenburg, "Soyuzgeofizika," "Crustal Structure of the Chu-Sarysuyskaya Depression and its Margins"]

[Abstract] The article presents the results of deep investigations by the reflected waves-deep seismic sounding method along the profiles Tyumen'-Aryk-Atasu and Lake Arys-Frunze, intersecting the Chu-Sarysuyskaya basin

and the principal structures along its margins. The Moho discontinuity is traced almost everywhere at depths of 40-44 km. In the consolidated crust no continuous discontinuities were detected. The intracrustal discontinuities are sloping, have limited dimensions and evidently constitute contacts between specific geological bodies. The morphology of the Mohorovicic discontinuity is closely interrelated to the relief of the top of the consolidated crust and their relationship is primarily inverse.

[2]

#### DETERMINING THREE-DIMENSIONAL DISTRIBUTION OF EARTH'S DENSITY

Kiev VISNYK AKADEMIYI NAUK UKRAINS'KOYI RSR in Ukrainian No 5, 1978 pp 16-20

[Article by G. O. Meshcheryakov, V. I. Starostenko, V. G. Kozlenko and Yu. P. Deyneka, "Determining the Three-Dimensional Distribution of Density in the Earth's Deep Layers in Connection with Construction of a Gravitational Model of the Tectonosphere"]

[Abstract] Due to the redistribution of energy and matter occurring in the earth, tectonic processes occur and affect magmatic processes, forming new minerals. One method for studying the earth's deep structure to predict and find mineral deposits is gravimetry. Anomalies in the earth's gravitational field can be indicative of subsurface deposits which cannot be detected by other methods. The gravitational field varies in some proportion to mantle density.

[459]

#### INVESTIGATIONS OF EARTH'S MANTLE IN UKRAINE

Kiev VISNYK AKADEMIYI NAUK UKRAINS'KOYI RSR in Ukrainian No 5, 1978 pp 8-15

[Article by Ya. M. Belevtsev, V. B. Sollogub, A. V. Chekunov, M. P. Shcherbak, G. I. Kalyayev and V. A. Zinchenko, "Investigating the Earth's Mantle in the Ukraine Using Deep and Ultradeep Drilling Techniques"]

[Abstract] The earth's mantle is investigated in various ways. For example, boreholes in the Ukrainian shield have penetrated as deep as 150-200 m, in some cases to 300-400 meters; in mineral deposit regions holes have been drilled as deep as 1,000-1,500 meters. Only gas and petroleum holes are drilled to a depth of 4-5 km. Experience in drilling superdeep holes has been obtained on the Kola Peninsula. Due to the great importance of superdeep drilling in solving many of the earth's riddles, superdeep holes must be sunk to 15-17 km in the Ukraine and conditions must be studied for sinking them as deep as 25-30 km. The most important data on the structure of

the mantle on the Ukrainian shield were obtained along deep seismic sounding profile VIII (along the shield from Taganrog to Podol'sk). The drilling of deep holes will help to solve the problem of the genesis and reserves of ore, petroleum and gas.

[459]

#### ROLE OF MECHANICAL FACTOR IN THERMAL REGIME OF FAULT ZONES

Moscow GEOTEKTONIKA in Russian No 4, 1978 pp 79-90

[Article by Ye. I. Patalakha, A. I. Polyakov and N. N. Sevryugin, Institute of Geological Sciences, Kazakh Academy of Sciences, "Role of the Mechanical Factor in the Thermal Regime of Zones of Major Faults"]

[Abstract] A study was made of the problem of release of secondary mechanical heat in fault zones. It is shown that the level of thermal energy at depths greater than 5 km is adequate for the metamorphization of rocks, at depths greater than 20-30 km -- for their partial melting. The principal patterns of geological structure and the thermodynamic regime of the zones along faults are explained. Long-lived regional faults in geosynclinally folded regions can be regarded not only as zones of concentration of stresses in the earth's crust, but also as generators of secondary local heat flow of thermomechanical origin whose intensity is determined by the strength properties of the rocks and the duration of fault activity. Under favorable conditions the level of concentration of tectonic stresses can be adequate for the appearance of metamorphic facies of superhigh pressures. The scale of metamorphism in this case is determined by the scale of the fault zone. In long-lived deep faults heat accumulation can be extremely significant and lead not only to an intense metamorphism of rocks, but also to the appearance of magma hearths. Since a decrease in hydrostatic pressure reduces the melting point of rocks, the most favorable tectonic regimes for the melting out of magmas are those which combine preceding prolonged compression (heat accumulation) with a subsequent sharp change of its time conditions for dilatation or unloading. Such regimes are characteristic for the concluding stages in the inversion period for the evolution of geosynclinal zones with transition from the fold-forming stage to the orogenic stage. [The article gives a schematic model of an elementary regional fault.]

[553]

## V. UPPER ATMOSPHERE AND SPACE RESEARCH

### News

#### "VENERA" PROBES ON COURSE TO VENUS

Moscow PRAVDA in Russian 26 Sep 78 p 3

[TASS Report: "On the Path to Venus"]

[Summary] Distant Space Communications Center. The flight of the "Venera-11" and "Venera-12" interplanetary probes, which were launched on 9 and 14 September 1978, is continuing. By 25 September the probes had travelled 5.5 and 4.1 million kilometers from the earth, and 39 communications sessions had been conducted. Their flight trajectory has been corrected in accordance with the program, and all systems relaying scientific and telemetric information are functioning normally. It is expected that "Venera-11" and "Venera-12" will reach the atmosphere of Venus on 25 and 21 December respectively.

[5]

#### CONDITION OF COSMONAUTS REPORTED FROM FLIGHT CONTROL CENTER

Moscow IZVESTIYA in Russian 24 Sep 78 p 1

[Article by B. Konovalov]

[Excerpt] For the first time in the history of cosmonautics the duration of flight is reckoned in three figures. On the night of 22 September the flight of the "Fotony" began its hundredth day. On the morning of 23 September Vladimir Kovalenok and Aleksandr Ivanchenkov noted this singular "anniversary" -- onset of the hundredth working day of flight. Only very recently such a flight duration would have seemed fantastic. But now we hear the buoyant voices of the cosmonauts, who are blazing the trail more and more distant into the unknown.

These days, naturally, everyone is excited by the question: how are they out there, what is their mood, how do they feel, are they able to work?

The physicians noted that V. Kovalenok and A. Ivanchenkov passed the period of adaptation more easily and it was shorter than for the preceding crews which had made prolonged flights. The principal physiological indices, although they experience some variations, are remaining at approximately the same level. Despite such a prolonged flight, tests with a carefully measured physical load and vacuum container have not shown any serious deviations. Detailed examinations using a set of different instruments, which are carried out once a week during special medical days, show that the physiological parameters are within normal limits.

The cosmonauts are sleeping well. They have a good appetite. But nevertheless there is a decrease in the volume of the lower leg, indicative of a decrease in the physical load in a state of weightlessness. The cosmonauts have lost a little weight. The more slender Aleksandr Ivanchenkov has lost more weight than Kovalenok.

In general, in the opinion of Doctors of Medical Sciences A. Yegorov and I. Kas'yan, who are making constant observations of the crew at the Flight Control Center, the physical state of the cosmonauts is good. They are giving a good forecast for the future.

The psychologists note the smoothness of the work, the good and friendly atmosphere on board. Kovalenok and Ivanchenkov are good complements to one another. The commander is more active and talkative. The ship's engineer is more restrained, judicious. With his silence Ivanchenkov successfully compensates the guitar concerts which give both great satisfaction.

The deputy flight director Viktor Blagov stated that the Control Center is very satisfied with the work of the "Fotony." The crew clearly performs absolutely all the missions assigned by the earth, is proceeding with initiative and is doing much above and beyond the program. Despite the fact that the hundredth day of flight has come, the volume of the planned work is not decreasing. The performance of the crew remains very high. Although, to be sure, things are not easy on them, they are working with boldness and in a good mood. The character of the radio conversations between the earth and the ship is businesslike, calm, friendly; the crew instantly reacts to jokes and is always ready to maintain a light-hearted conversation. And this is a very simple but true index of a good feeling of well-being.  
[11]

#### "SOYUZ-31" EXPERIMENTS OUTLINED

Moscow KRASNAYA ZVEZDA in Russian 30 Aug 78 p 3

[Article by V. Ovcharov: "Work is the Most Important Thing"]

[Excerpt] Today scientists are already investigating the effect of weightlessness on the finest mechanisms of living matter. The "Culture Tissue" experiment, for example, is solving this problem on the cell and tissue

levels and should assist in answering the question as to how flight factors in space exert an influence on elementary biological processes in the cell, being the structural unit of the living organism. Scientists want to determine what changes will occur in cell division, in metabolism, in the properties of cell membranes, in the exchange of information between the cells and their environment.

This experiment is being carried out in the "Vkladysh" [insert] instrument. This is a set of special polymer flasks with a tissue culture which are in a sealed case. The instrument, fabricated in East Germany, was delivered in a special thermostat at a temperature of  $+4^{\circ}\text{C}$  to the cosmodrome at Baykonur. In such a "preserved" state the "Yastreby" transported a tissue culture on board the "Salyut-6," where then, for "vitalization" it was placed in the thermostat. The culture will live in a state of weightlessness for five days at a temperature of  $+37^{\circ}\text{C}$ . Then the cosmonauts will return it to the earth.

The objectives of the other three experiments are microorganisms. Possibly this thought will seem absurd, but who knows whether man one day may build a monument to these bacteria, similar to the monument to the dogs, the experiments on which gave man highly valuable knowledge concerning himself, which now stands near the institute where the great physiologist I. P. Pavlov worked. Indeed, precisely they, the most inconspicuous but also the most viable of the organisms on our planet, have become one of the most promising models for investigations in the long run associated with the creation of biological life support systems for man during prolonged space flights to other planets, and possibly the Galaxy. Bacteria and the Galaxy. Thus there is a closure of the dialectic ring of knowledge of nature, in which there is nothing excess and everything is interrelated.

A month of spaceflight occupies less than one-thousandth of man's lifetime. During this same time a white mouse passes one-thirtieth of the life span allotted to it. During this time the fruit fly *Drosophila* is both born and dies. But for a bacterium a month is an entire era. Hundreds of generations succeed one another during these thirty days. How will the first and last generations differ from one another? What will happen to the "offspring"? How will they use their powerful adaptive forces so that they can live there where there is neither up nor down?

The experiments "Joining of Microorganisms" and "Metabolism of Bacteria" involve equally interesting problems. The first of these lies in the realm of research clarifying the influence of weightlessness on the geometry, mechanism of formation and stability of structures during the joining of microorganisms with organic polymers. With respect to the experiment "Metabolism of Bacteria," it is used in studying the influence of weightlessness on metabolism in cells. Each experiment is duplicated on earth for comparison of the results and analysis.

[8]

## GUROVSKIY REPORTS ON HEALTH OF COSMONAUTS AFTER 100 DAYS

Moscow SEL'SKAYA ZHIZN' in Russian 24 Sep 78 p 3

[Article by N. N. Gurovskiy: "A Hundred Days in Orbit"]

[Text] Today marks 101 days of work in orbit by the cosmonauts V. Kovalenok and A. Ivanchenkov. The head of the Space Medicine Administration of the USSR Health Ministry, Professor Nikolay Nikolayevich Gurovskiy, tells about the problems of biomedical support of the most prolonged flight in the history of cosmonautics:

The present space flight, like all the preceding expeditions of cosmonauts aboard the "Salyut" stations, has become part and parcel of our everyday life. Today, when the 96-day record of work in space by Yu. Romanenko and G. Grechko has been surpassed, all earthlings are naturally interested in the question: how do V. Kovalenok and A. Ivanchenkov feel and how is their high performance ensured?

Behind the terse lines of the daily reports on the flight is hidden the saturated emotional activity of the cosmonauts. They are implementing missions formulated by specialists in the most different fields of knowledge: physicists, technologists, space "geographers," agriculturalists and many others.

But there is a science present aboard the orbital complex every second. This is space medicine. On the earth the physicians constantly monitor the state of the crew's health and the operation of the life support systems in the complex. The physicians are always ready to come to the assistance of those who are in orbit. And the cosmonauts themselves carry out medical self-monitoring, are engaged in physical exercises, and carry out all those recommendations which are directed toward ensuring the optimum regime of their work and life.

I would like to note that the cosmonauts V. Kovalenok and A. Ivanchenkov even before the flight told us that there would be a clear and rigorous adherence to all the recommendations which the physicians give. And they have kept their promise: we have no doubt as to the state of their health.

To be sure, at times they have headaches and they feel some fatigue, increased in dependence on the work which has been carried out. But all this passes. The cosmonauts very rarely have recourse to the pharmacy aboard the ship; most of all they like to drink eleuterococcus. This is a tonic, somewhere between a food product and a medicine. Now, judging from biotelemetric data, the crew feels good and we are looking optimistically at its prolonged activity. The fact that cosmonauts have tolerated a state of prolonged weightlessness is of more than a little importance in preflight training at the Training Center. This crew, the same as others, prior to the flight slept in a position in which the legs were above the head. This is done in order to cause an inflow of blood to the upper part of the body --

to the head and chest -- as will be the case in a state of weightlessness. Simulating such a state on earth, we thereby train the blood circulation regulation mechanisms and this is a preparation for the conditions of orbital flight. During the first period of emergence into orbit the feeling of well-being of this crew was excellent.

In general, however, if we are to speak of progress in the field of space biology and medicine, the following must be noted. When we had just begun research there was much that was unclear. Some even assumed that weightlessness and man's life in this state were incompatible, that the blood could not move through the vessels and that breathing would be difficult due to disorder in the coordination of movements. But the very first flight refuted all these fears. Behind us is this 100-day flight and tens of others of a lesser duration. Very abundant experimental data have been collected and now the requirements on the state of health of those persons who are selected for subsequent flights are less rigorous.

And nevertheless we have still not finally solved many problems in the field of space biology and medicine. We still do not know precisely about the processes of man's adaptation under conditions of prolonged weightlessness, such as, for example, the washing of calcium salts from the bones; we have still not thoroughly studied the problems related to hormonal changes. There has still been no final interpretation of the mechanism of the influence of weightlessness on the vestibular apparatus, especially during prolonged flights.

There is much which still must be done in developing methods for readaptation after prolonged flights, although the methods and apparatus for preparation for return of the human organism to terrestrial conditions have been well tested. This preparation already begins in orbit. For example, the space physical trainer installed in the work compartment of the station makes it possible to walk and run, it is possible to squat and run on it and simulate work with a barbell. Special rubber lines give a load equal to approximately 50 kg, that is, close to the terrestrial weight. On the bicycle-type ergometer, an unusual velocipede, the body of the cosmonaut can receive a carefully measured load. These apparatuses also are used for medical research. The physicians, by means of the telemetric system, can evaluate on earth how the body of the cosmonaut reacts to any load as time passes.

The data show that approximately from the fourth-sixth weeks the state of the cosmonaut's body reaches a stable level. We anticipate that V. Kovalenok and A. Ivanchenkov will satisfactorily tolerate the return to terrestrial conditions.

In the struggle with weightlessness we are also assisted by other means. Almost all the working day the cosmonauts wear the "Pingvin" load suits into which rubber strands are sewn, in a way causing the body to be bent. They must at all times strain their muscles so that the knees will not be drawn

up to the chest and so that the back will be straight. Such a load makes it possible to maintain the performance of those muscles which under terrestrial conditions enable man to maintain a vertical posture.

It should also be noted that the "Chibis" vacuum suit outwardly resembles a diver's suit. After sealing the waist, the cosmonauts evacuate the air and create a rarefaction. Then the pressure on the upper half of the body becomes greater and the blood rushes downward. This is a simulation of a process opposite to that which was carried out prior to the launching. Now preparations are being made for terrestrial gravity.

There are separate problems, such as immunity and immunoreactivity, that is, man's nonsusceptability to infectious diseases. If a man or a small group is confined for a prolonged time in a sealed, closed space, there will be a substantial change in the microflora in it, and accordingly, the reaction to it -- immunity. These problems, like a number of others, require detailed study.

In ending this discussion of the problems of space biology and medicine, I would like to note that the conditions of space and spaceflight itself do not give rise to occupational pathology in cosmonauts. This is confirmed by the experience of preceding flights and the condition of those cosmonauts who have visited space two or three times. All the changes which have been observed in them have vanished completely and without a trace.

I hope that V. Kovalenok and A. Ivanchenkov, now surpassing the 96-day record of presence in space established by their predecessors Yu. Romanenko and G. Grechko, will also illustriously carry out the planned program of research and experimentation and will also tolerate well the encounter with terrestrial gravity conditions.

[9]

#### MATERIALS PROCESSING CONTINUES IN "SPLAV" AND "KRISTALL"

Moscow PRAVDA in Russian 26 Sep 78 p 3

[Article by S. Grishin: "Space Crystals"]

[Text] The international crew of the space orbital complex "Salyut-6"- "Soyuz-29"- "Soyuz-31" has carried out a series of technological experiments using the "Splav" and "Kristall" apparatus. The Soviet cosmonauts V. Kovalenok, A. Ivanchenkov, V. Bykovskiy and the cosmonaut researcher from East Germany, S. Jaehn, have received new materials which will find extensive use in many branches of science and technology.

Investigations in the field of space technology have become an important part of the scientific program carried out by cosmonauts aboard the "Salyut-6"- "Soyuz" complex. Planned experiments in this field had already begun on

board the "Salyut-5" station. Important data were obtained on the processes of heat and mass exchange under orbital flight conditions when the technological samples are acted upon by negligible accelerations a thousand to a hundred thousand times less than under terrestrial conditions. The cosmonauts cultivated crystals of potash alum and soldered objects of stainless steel using a high-temperature manganese-nickel solder.

Technological experiments have been further developed aboard the "Salyut-6"- "Soyuz" complex. In particular, specialists are testing and improving new equipment -- electric heating apparatus designed for the cultivation of semiconductor crystals.

The principles for the designing and construction of the apparatus are for the time being based on available terrestrial experience. However, with their use in space it is necessary to ensure the required thermal regimes for heating and cooling of the samples in the absence of free convection and a high accuracy in maintaining the stipulated temperature. The apparatus must have low energy requirements and a small mass and also have a sufficiently great work reserve and a high reliability. There must also be a high degree of automation of technological processes and a maximum autonomy. The apparatus must be resistant to fire and explosion and during its operation must not release harmful toxic substances.

An electric heating apparatus, the "Splav-01," was delivered to the "Salyut-6"- "Soyuz" complex aboard the "Progress-1" automatic freighter. The "Splav-01" was used in carrying out important technological experiments, including by international crews. The apparatus ensures heating of materials to 900-1,000 degrees Celsius and has three temperature zones: "high" (900-1,000°), "low" (600-700°) and gradient, where the temperature linearly decreases from "high" to "low." These experiments show that there are some differences in the heating of matter under conditions of microaccelerations and on the earth. The cooling of the "Splav-01" apparatus occurs due to the radiation of heat directly into space.

The "Progress-2" ship delivered to the station a new, modified electric heater known as the "Kristall," including an electric furnace, a control device and holders with containers which hold capsules with the substances to be tested. This apparatus is designed for the cultivation of semiconductors in the form of bars, three-dimensional crystals or epitaxial structures from melt, the vapor or gas phases. It is autonomous and ensures a high degree of automation of the processes. They can be carried out in the range 400-1,200 degrees Celsius.

The apparatus is supplied with an air-cooling system and is placed within the transfer compartment of the orbital station, which is more convenient for the crew. The "Kristall" is characterized by a high perfection of the thermal processes and the heat-regulating system aboard is adequate for carrying off the released heat.

The computations made using an electronic computer indicated that under conditions of small accelerations the heat and mass exchange in the fluid media is dependent on a number of parameters, such as the geometrical dimensions of the technological system, the thermophysical characteristics of the matter, the magnitude of the imparted accelerations, etc. Accordingly, the formulation of any technological experiment in space is preceded by the devising and analysis of a mathematical model of the processes under conditions of small accelerations.

Experiments in space are supplemented by experiments on a centrifuge at high accelerations. Such complex investigations make it possible to develop effective methods for computing the technological processes for obtaining perfect crystals, composition materials, optical glass, etc.

A matter of great interest to scientists and specialists is a direct study of the technological samples obtained on board the orbital stations. Here there is usually much which is new and unexpected. For example, the crystals cultivated from solutions during the flight of the "Salyut-5" station are different from the crystals obtained on earth both with respect to external appearance and internal structure. The samples contained an increased quantity of gas-fluid inclusions. Their source is evidently bubbles of a gas dissolved in the fluid. Degassed solutions are used in the experiments aboard the "Salyut-6."

Step-after-step our knowledge is being improved in the field of space technology. And the experiments being carried out in the "Salyut-6"- "Soyuz" complex through the joint efforts of the socialist cooperation countries are giving new and interesting results.

[10]

#### "MEDUZA" BIOLOGICAL EXPERIMENT DESCRIBED

Moscow KRASNAYA ZVEZDA in Russian 24 Aug 78 p 3

[Article by V. Ovcharov: "The 'Meduza' Experiment"]

[Abstract] The possibility of an abiogenous synthesis of organic substances on the earth is today unquestionable: by modeling in laboratory conditions the planet when it was "young," scientists have succeeded in synthesizing both the simplest carbon compounds, as well as amino acids, polypeptides, polynucleotides. Space investigations and radioastronomical observations have shown that even in different regions in interstellar space there are a great number of carbon compounds, frequently extremely complex and high-molecular, which in the opinion of scientists are synthesized in particles of interstellar dust clouds, highly irradiated by star radiations. In other words, organic substances were formed in space not only long before the appearance of life on earth, but even prior to the birth of the planet. It is

to this part of the hypothesis which Vladimir Kovalenok and Aleksandr Ivanchenkov are turning their attention in a highly interesting experiment. Strictly speaking, the "Meduza" experiment began simultaneously with the launching of the "Salyut-6" into circumterrestrial orbit, since it was precisely with this moment that the containers mounted on the outside of the station began to be subjected to the influence of space. One set of containers held amino acids of four types, whereas the other set held fragments of RNA and DNA molecules. Some sets were exposed to both regular and ultraviolet radiation, whereas others were exposed only to the UV radiation. Still others were reliably shielded.

The model experiments on the earth which we have already mentioned indicated that under the influence of ordinary radiation, UV radiation and electric discharges such initial substances are capable of forming polymer chains. Was it possible to obtain evidences of living matter in space? Scientists will be able to answer this question when the experimental materials are returned to the "cradle of life," to our planet.

[7]

#### PROCESSING OF DATA FROM SPACE COMPLEX DISCUSSED

Moscow KRASNAYA ZVEZDA in Russian 16 Aug 78 p 3

[Article by B. Pokrovskiy: "A River Flowing With the Speed of Light"]

[Abstract] Today the radio exchange between the orbital complex and the earth resembles a powerful and continuous "electronic conveyor belt." This "conveyor belt" consists of automated communication lines and high-capacity, high-speed electronic computers making it possible not only to transmit and process enormous flows of information, but also to "show" the results of processing virtually at a real time scale on luminescent maps simulating the motion of the complex on electronic displays and television screens where the information is renewed each three seconds. With respect to content, the information can be classified as orbital, telemetric, programming-command, television and conversations with crews. The quantity of telemetric information exceeds by several orders of magnitude the volume of the orbital and programming-command information taken together. The total volume of information received from the "Salyut-6"- "Soyuz" complex by one ground measuring station in a single session exceeds a hundred million binary digits... During a month the ground and ship tracking stations conduct about 500 communication contacts with the "Salyut-6"- "Soyuz"... Even today scientists are thinking about ways to improve further the communications which exist between the earth and orbit. Specialists are at work solving the problem of reducing the complexity of decoding devices, reducing the minimum power of a television transmitter without worsening image quality, etc.

[5]

## PHARMACEUTICALS ON BOARD "SALYUT-6" STATION

Moscow KRASNAYA ZVEZDA in Russian 19 Aug 78 p 4

[Article by Ye. Balanov: "Pharmacy for Cosmonauts"]

[Excerpt] There are also pharmacies aboard ships and orbital stations. At first glance it is the ordinary sort of thing: bandages, cotton, plasters, a variety of medicines but...Special, specific requirements are imposed here on each medical preparation...Even before the flight special investigations are carried out of the individual sensitivity of the cosmonaut's body to different medicines, making sure that the drugs do not have a negative effect on the performance of man under weightlessness conditions.

Here is what V. A. Shatalov stated in his book entitled TRUDNYYE DOROGI KOSMOSA (Work Roads of Space) with respect to the drug dimedrol, which is known to everyone: "After taking one small tablet of dimedrol, I then went around all day like in a fog -- I had become indifferent to everything, my legs became like cotton and I wanted to lie down to sleep. I tried to run an exercise on the bars but nothing helped, the whole day was wasted. I drew the conclusion that dimedrol was not for me..."

Naturally, in selecting a space pharmacy it is impossible to get by only with the arsenal of known medicines. For example, such an active calming agent as seduxen proved to be unsuitable for increasing performance under conditions requiring maximum psychic and emotional stress and also for normalization of the "sleep-wakefulness" cycle. Seduxen at times causes undesirable side effects -- muscular weakness. Trioxazine does not produce side effects but has a weak calming effect. And only phenibut has justified hopes. On the day following its administration the cosmonauts stated: "Our feeling of well-being was good, sleep was refreshing, and despite the work stress, we did not feel fatigue."

But even after the medicines were selected, different problems arose. The fact is that medicines in such medical forms as ointments, drops and volatile substances do not always correspond to the specific requirements which are imposed on articles carried aboard spaceships and therefore they cannot be included in the on-board pharmacies. But that is not all. It was found that the preservability of medicines is influenced by spaceflight factors: vibrations, accelerations and shock impacts and a vacuum. Therefore, it was necessary to develop procedures and methods for the rational placement and attachment of medicines.

A special design of the packaging for liquid, soft and hard medicines, devices excluding the possibility of spontaneous escape of the contents into the atmosphere of the cabin, and maximum convenience in use of the on-board pharmacy under such unusual conditions of weightlessness -- all this is taken into account in outfitting of crews on a prolonged space voyage.

In the cosmonaut pharmacy for ships of the "Soyuz" type and orbital stations of the "Salyut" type there are many different drugs. These include cardiovascular, pain-allaying, gastrointestinal, anti-inflammatory, antibacterial and antiradiation drugs, as well as medicines eliminating vestibular-autonomic disorders. For flights with a duration of more than ten days the pharmacies include drugs for normalizing water-salt and protein metabolism.

[6]

## Abstracts of Scientific Articles

### SPECTRAL CHARACTERISTICS OF SOLAR COSMIC RAYS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 4, 1978 pp 583-589

[Article by N. A. Mikirova and N. K. Pereyaslova, Institute of Applied Geophysics, "Characteristics of Temporal and Spectral Characteristics of Solar Cosmic Rays Caused by the Influence of the Sectoral Structure of the Interplanetary Magnetic Field"]

[Abstract] This article presents the results of a comparison between magnetic fields on the sun and the observed peculiarities in the distribution and spectral characteristics of solar cosmic rays with energies  $E_p \gg 5$  MeV, registered in the high-latitude zones of the earth's magnetosphere at altitudes 700-1,000 km and with energies  $E_p \gg 10$  MeV on the "Explorer" artificial earth satellite. The article gives a detailed analysis of solar cosmic ray events observed during the periods 7-8 September 1973 and 12-13 April 1973. The conclusion is drawn that the time profile, spectral characteristics and arrival time of proton fluxes at the earth are determined by the configuration of photospheric magnetic fields on the sun.

[555]

### STUDY OF IONOSPHERIC PROPERTIES ON HIGH-LATITUDE RADIO PATH

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 4, 1978 pp 638-641

[Article by D. V. Blagoveshchenskiy, N. F. Blagoveshchenskaya and Yu. A. Kurchenko, Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Investigation of Frequency-Correlation Properties of the Ionosphere on a High-Latitude Radio Path"]

[Abstract] This paper discusses the results of frequency-spaced reception of short-wave signals on a radio path passing along the auroral zone. The investigations were made along a path with the extent  $D = 1,450$  km. There was reception of monochromatic signals simultaneously at three frequencies with the frequency spacing  $\Delta f = 0, 3$  and  $6$  KHz. At nighttime there was also

a frequency spacing  $\Delta f = 12$  KHz. Observations were made with V-shaped antennas with a ray length 40 m and P-250M2 receivers with output to a high-speed automatic recorder. The observations were made in winter, around-the-clock. The range of working frequencies was 6-17 MHz. Four hundred observation sessions were processed. The authors give an analysis of the dependence of the frequency correlation coefficients for signals under different geophysical conditions, especially during auroral substorms. An evaluation is given for different ionospheric parameters: coefficient of ionospheric turbidity; dimension of small-scale inhomogeneities; angular spectrum of scattered waves; drift velocity; ionization gradient in the ionosphere.  
[555]

#### MODEL OF INTERACTION BETWEEN ELECTRON STREAMS AND ATMOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 4, 1978 pp 610-614

[Article by O. M. Pirog and V. D. Urbanovich, Norilsk Polar Space Physics Polygon and Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Model of Interaction Between Electron Streams and the Atmosphere"]

[Abstract] The authors present evaluations of the evolution of the energy structure of the primary stream of electrons at different altitudes, taking into account the formation of secondary electrons. This makes it possible to determine the ionization rate for different components of the atmosphere using ionization sections, to evaluate the excitation of optical emissions, the heating of the electron-ion gas and the atmosphere. There was found to be a dependence of the energy spectrum of the total stream on the pitch-angle distribution. The article gives computations of the vertical profiles of the rate of formation of the principal ions for different initial energy and angular spectra. The results of evaluations of the energy spectrum of the electron stream with penetration into the atmosphere for different pitch-angle distributions are of great interest from the point of view of computations of the vertical profiles of the emissions and heating of the ionosphere and atmosphere.  
[555]

#### PENETRATION OF PROTONS INTO AURORAL REGIONS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 4, 1978 pp 728-730

[Article by N. A. Mikarova and N. K. Pereyaslova, Institute of Applied Geophysics, "Characteristics of Penetration of Protons into Auroral Regions"]

[Abstract] This paper gives an analysis of the spatial distributions of fluxes of protons with  $E_p > 90$  MeV at altitudes 700-1,000 km during the event of 7 September 1973. During the period of this event in the high-

latitude zones of the earth's magnetosphere there was registry of a prolonged north-south asymmetry at energies 5-90 MeV. In the spatial distribution of solar cosmic rays over the polar caps there was registry of inhomogeneities with clearly expressed auroral, polar and cusp peaks. In the region of the auroral oval there was a morning-evening asymmetry in the streams of solar cosmic rays, being manifested in an exceeding of the maximum level of intensity of auroral peaks for the morning local hours over the intensities of solar cosmic rays for the evening hours. At the beginning of injection the streams of protons in the auroral zone in the eastern part of the latitude profile exceed by a factor of 2.7 the streams of protons at the maximum of the auroral peaks in the western part and only four hours after onset of registry of the solar cosmic rays become identical. These and other peculiarities of phenomena in the auroral oval can be explained on the basis of existing concepts concerning the dynamics of the magnetosphere during the time of a substorm. The analysis of the spatial distributions of solar cosmic rays with  $E_p > 90$  MeV confirmed the morning-evening asymmetry of penetration of protons into the auroral regions and movement of the maximum of the auroral peak and the polar boundary of the evening auroral region toward large invariant latitudes with an increase in geomagnetic disturbance.

[555]

#### DETERMINING ANGULAR ELEMENTS OF OUTER ORIENTATION OF STAR PHOTOGRAPH

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA in Russian No 3, 1978 pp 53-59

[Article by M. I. Shcherbakov, Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers, "Evaluation of the Accuracy in Determining the Angular Elements of Outer Orientation of a Star Photograph"]

[Abstract] In determining and evaluating the accuracy of the angular elements of outer orientation of a star photograph the author employs the photogrammetric relationships between the coordinates of stars and the elements of inner and outer orientation of a star photograph and has written correction equations which are solved by the least squares method. It is shown on the basis of modeling that in determining the angular elements of outer orientation of a star photograph with any focal length by the least squares method with additional unknowns for all practical purposes it is sufficient to have 13-15 stars uniformly distributed over the entire photograph field. Under these conditions and a focal length of the photograph of 450 mm and present-day accuracy in determining the elements of inner orientation and star coordinates it is possible to obtain the angular elements of outer orientation of a star photograph with a stipulated accuracy.

[562]

## RECTIFICATION OF PHOTOGRAPHS TAKEN AT GREAT ALTITUDES

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA  
in Russian No 3, 1978 pp 97-102

[Article by B. V. Krasnopevtseva, Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers, "Rectification of Photographs Taken from Great Altitudes"]

[Abstract] The article examines solution of one of the problems in the photogrammetric processing of space photographs -- rectification of photo images taken from great altitudes. Whereas the rectification of aerial photographs is difficult due to the necessity of taking into account the influence of local relief, on the photographs taken from space this factor becomes secondary and all attention is concentrated on making allowance for curvature of the photographed surface. This article covers the subject of rectification of such photographs. Also examined are the peculiarities of rectification of space photos on photorectifiers of the optical-mechanical type. The photograph is divided into zones within which the level surface can be approximated by a plane. Formulas are derived for computing the dimensions of the zones. Recommendations are given on selection of the photograph from which it is best to carry out rectification of the zone. The number of rectified zones is dependent on the curvature of the planetary surface and the area shown on the photograph. The number of rectification points on the photograph should ensure rectification of all the zones. The coordinates of the rectification points are determined by the spatial phototriangulation method with their subsequent recomputation into the corresponding cartographic projection.

[562]

## INFORMATION CONTENT OF REMOTE OZONE MEASUREMENTS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 14, No 8, 1978 pp 866-875

[Article by O. M. Pokrovskiy and Ye. Ye. Kaygorodtsev, Leningrad State University, "Information Content of Remote Measurements of Ozone in the Atmosphere"]

[Abstract] This is a discussion of a method for evaluating the information content of data from remote measurements of gaseous components in the atmosphere. The authors examine its application to an analysis of the information content of remote sensing in the IR absorption bands of ozone (9.6 and 8.9  $\mu\text{m}$ ). There is also a discussion of the information structure of data from measurements of the spectral and angular distribution of the characteristic radiation of the atmosphere-earth system, and also transparency on slant paths. The characteristics of the information content are compared

for different schemes for carrying out the experiment. A scheme for matched measurements is presented. Recommendations are given for the selection of the optimum spectral zones. Measurements at the nadir provide the least information. But they are valuable because they contain information on the upper troposphere. The measurements in the absorption bands 9.6 and 8.9  $\mu\text{m}$  mutually supplement one another. Both described experimental schemes for the most part cover the upper and middle stratosphere. The matched measurement scheme (nadir and limb) makes it possible to attain a more uniform information content in a vertical section.  
[578]

#### CHOICE OF FAMILY OF CARRIER-ROCKETS FOR SPACE PROGRAM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 16, No 4, 1978 pp 514-521

[Article by A. V. Sollogub and V. P. Ofitserov, "Choice of a Family of Carrier-Rockets for Carrying Out the Space Research Program With Multiple Launchings"]

[Abstract] The authors examine methods for solving the problems arising when validating the choice of a family of carrier-rockets for implementing the space research program and the program for the construction of space vehicles, taking into account the multiple use of carrier-rockets and vehicles. Included in the article are formulations of problems in whole-number programming and algorithms are given for their solution by the dynamic programming method, making use of the approach described earlier by these same authors (KOSMICH. ISSLED., 15, No 6, 1977). These algorithms can be used in automated planning systems.  
[548]

#### MOTION OF AURORAL ARCS IN THE POLAR CAPS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 4, 1978 pp 744-745

[Article by V. A. Sergeyev and A. G. Yakhnin, Leningrad State University, and Polar Geophysical Institute, Kola Affiliate USSR Academy of Sciences, "Motion of Auroral Arcs in the Polar Caps"]

[Abstract] A study was made of the motion of auroral arcs in the polar caps over Resolute Bay station during 1957-1958 and over Vostok station during observation periods in May 1965, April 1968 and in June-August 1972. A total of 117 cases of moving arcs were selected for the northern hemisphere and 82 for the southern hemisphere. In both the northern and southern hemispheres there was a predominance of movements from the edge of the cap

toward the center. The authors believe that the mechanism of formation of polar cap auroras involves the acceleration of electrons in longitudinal electric fields associated with nonuniformities of the electric field in the polar cap ionosphere. The appearance of such nonuniformities is possible 1) due to nonuniformities of conductivity in the polar cap ionosphere or 2) due to the nonuniformity of the field of velocities of flow around the magnetosphere under the condition that all the lines of force emanating from the polar cap join with the lines of force of the interplanetary magnetic field or 3) on the lines of force emanating from the cap there are plasma blobs moving across the field. The third possibility is most promising for explaining the observed pattern of motion of auroral arc movement. Extensive plasma blobs can penetrate into the magnetosphere from the solar wind. In this case a blob having a momentum in a direction across the field should be polarized, and leakage of polarization charges along the lines of force and their dissipation in the ionosphere causes the presence of longitudinal currents and longitudinal electric fields necessary for the acceleration of electrons. The movement of auroras toward the center corresponds to movement of the blob into the depth of the magnetosphere. A decrease in momentum and kinetic energy of the blob with its penetration deeper into the magnetosphere, caused by dissipation in the ionosphere, should lead to a decrease in the probability of the appearance of polar cap auroras closer toward the center, and also to the presence of a predominant direction of movement, in agreement with the experimental results.

[555]

#### BOLIDE PHENOMENA ACCOMPANYING SPACECRAFT DESCENT

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 12, No 3, 1978 pp 184-185

[Article by V. S. Getman and M. N. Maksumov, Astrophysical Institute, Tadzhik Academy of Sciences, "Bolide Phenomena Accompanying Spacecraft Descent"]

[Abstract] Observations of glow and luminescence caused by the descent of spacecraft are discussed. The luminescence accompanying the descent of a spacecraft in the atmospheric segment consists of components of different nature since it is caused by the heating of the air by a shock wave, luminescence of the evaporating thermal insulating layer of the spacecraft (this can be called "meteoric" luminescence) and combustion of the evaporating matter and spacecraft surface. The predominance at the beginning of the luminescence of the molecular bands and atomic lines of atmospheric origin in the Fire I spectrum indicates that the luminescence is caused by the heating of air by the shock wave, whose radiation is close to equilibrium. Then this luminescence begins to be maintained also by combustion. The "meteoric" luminescence is probably not predominant, giving a brightness of only  $-8^m$  -  $-10^m$ . The presence in the spectrum of oxide bands confirms that a brightness of  $-19^m$  -  $-21^m$  can be ensured by the explosive combustion of metal.

[574]

## DISTRIBUTION OF MOLECULAR NITROGEN IN UPPER ATMOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 4, 1978 pp 645-651

[Article by M. N. Vlasov, V. I. Chernyshev and V. G. Kolesnik, Institute of Applied Geophysics and Siberian Physical-Technical Institute at Tomsk University, "Distribution of Molecular Nitrogen Determined from Vibrational Levels in the Upper Atmosphere"]

[Abstract] On the basis of a numerical solution of a system of equations describing vibrational relaxation of molecular nitrogen the authors have computed the time during which a Boltzmann distribution should be established for vibrational levels of  $N_2$  in dependence on altitude and the initial vibrational temperature. Specifically, in the middle-latitude ionosphere in the region of altitudes 120-150 km the time of the vibrational relaxation of  $N_2$  is several minutes, which is considerably less than the lifetime  $N_2(r)$  due to other processes. This confirms that the distribution of  $N_2$  molecules by vibrational levels is a Boltzmann distribution.  
[555]

## DISTRIBUTION FUNCTION FOR ELECTRONS IN LOWER IONOSPHERE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 4, 1978 pp 603-609

[Article by I. A. Krinberg and L. A. Akatova, Siberian Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation and Irkutsk State University, "Distribution Function for Electrons in the Lower Ionosphere and its Correlation with the Rate of Formation and Heating of Electrons. I"]

[Abstract] Only a few studies have been devoted to computation of the distribution function of electrons in the field of thermal and superthermal energies. Earlier authors, with a number of significant limitations, obtained an analytical solution for the kinetic equation and solved such an equation numerically in more complete form. Later a sufficiently general analytical solution was obtained for isotropic plasma with an electron source. Here the authors give an analysis of this solution for conditions in the lower ionosphere ( $h \approx 250$  km). It is shown that the electron distribution function can be represented in the form of the sum of a Maxwellian function and a function related to the action of a source of superthermal electrons. It was found that deviations from a Maxwellian distribution become appreciable with energies above  $\sim 14 T_e$ . A method is proposed for determining the total rate of ion formation from the values of the distribution function.  
[555]

## NUMERICAL INTEGRATION OF DIFFERENTIAL EQUATIONS OF SATELLITE MOTION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA in Russian No 3, 1978 pp 40-46

[Article by Yu. V. Plakhov, Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers, "Method for Refining the Results of Numerical Integration of the Differential Equations of Satellite Motion"]

[Abstract] As a result of systematic errors in integration of the differential equations of motion by any of the difference methods the resulting solution becomes divergent with such values of the argument when the series representing the solution should theoretically converge. This leads, in particular, to a narrowing of the interval of suitability of the solution with an increase in the stipulated accuracy of the computations. This is particularly reflected in the results of integration of the equations of satellite motion for solution of problems in space geodesy; the geodetic information is frequently lost in integration errors. The author therefore proposes a method which to a certain degree eliminates the mentioned shortcoming in difference methods for numerical integration. The method is based on a numerical variant of the Picard method with the use of quadrature formulas with the highest algebraic accuracy.

[562]

## STRUCTURE OF ELECTRIC FIELDS IN AURORAL FORMS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 18, No 4, 1978 pp 673-679

[Article by M. I. Pudovkin and V. M. Uvarov, Leningrad State University, "Structure of Longitudinal Electric Fields and Currents in Auroral Forms"]

[Abstract] In this study an attempt is made to clarify the role of plasma turbulence in the excitation of electric fields and currents in the auroral ionosphere. This is essentially a continuation of an earlier investigation by the authors (GEOMAGNETIZM I AERONOMIYA, 15, 1033, 1975). Here they have computed the electric fields and currents in auroral arcs and rays on the assumption of ionospheric turbulence of ionospheric plasma. The structure of longitudinal currents in auroral rays determined in the computations corresponds to the experimentally observed structure with values of the degree of turbulence from 0.01 to 1. The hypothesis of localization of turbulence in the tube of lines of force containing an auroral form makes it possible to explain the intensity and direction of the longitudinal electric fields and the structure of the longitudinal currents in an auroral arc. The predominant carriers of longitudinal currents in an auroral arc are auroral electrons for the upward-directed longitudinal current at the center of the arc and ionospheric electrons for the downward-directed longitudinal current on the equatorial edge of the arc.

[555]

## INTENSITY DISTRIBUTION OF COSMIC GAMMA RADIATION

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 4, No 8, 1978  
pp 349-352

[Article by Ye. P. Mazets, S. V. Golenetskiy, R. L. Aptekar', V. N. Il'inskiy and V. N. Panov, Physical-Technical Institute USSR Academy of Sciences, "Intensity Distribution of Cosmic Gamma Radiation Bursts"]

[Abstract] The nature of the gamma bursts discovered by R. W. Klebesadel (1973) continues to remain unknown. Until now it is not even clear whether the sources of gamma bursts are galactic or intergalactic. This paper gives new data on the low frequency of registration of low-intensity gamma bursts and it is shown that the inevitable observational selection can lead to very strong deviations of the experimentally determined distributions from the real distributions; therefore, the interpretation of the observational distributions must be approached with great caution. The experimental part of the study was based on observations made with the "Kosmos-461" satellite in 1971-1972 and with the "Meteor" satellite in 1977. The data presented in this article indicate a galactic origin of this radiation. However, any final conclusion concerning the galactic nature of gamma bursts will become possible only when it is established that there is an angular anisotropy of the distribution of sources of bursts and their concentration toward the galactic plane.

[579]

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